SOME VARIATIONS IN PROPERTIES OF THE PEORIAN LOESS AND THEIR PEDOLOGIC SIGNIFICANCE

BY

GUY DONALD SMITH

B.S., University of Illinois, 1930

M.A., University of Missouri, 1934

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRONOMY IN THE GRADUATE SCHOOL OF THE UNIVERSITY OF ILLINOIS, 1940

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SOME VARIATIONS IN PROPERTIES OF THE PEORIAN LOESS AND THEIR PEDOLOGIC SIGNIFICANCE

Differences in soil character have been observed throughout the Mississippi valley to be associated with differences in the thickness of the loess deposits and with differences in distance from the source of the loess. It was the purpose of this investigation to study the relationship between the character of the loess deposits and the distance from the loess sourse, the river flood plains.

The loess from two sources was studied. One was along the Illinois River in Cass and Mason counties where the glacial flood plain is very wide. The other was the American Bottoms along the Mississippi river near St. Louis. Measurements were made of the thickness of the loess deposit, and samples of the calcareous loess were collected, in straight lines from these sources. These lines were laid out as nearly as possible in the direction of the prevailing winds during the period of loess deposition. The samples of calcareous loess were subjected to mechanical analysis by the pipette method, and the calcium carbonate equivalent was estimated from the total carbon determination by dry combustion.

Differences in particle size of the calcareous loess were found to be a linear function of the logarithm of the distance from the bluffs along the flood plains. The mean particle size of the calcareous loess from the Cass-Mason county area decreased from 30.6 microns at 1.5 miles from the bluff to 16.4 microns at a distance of 65 miles from the bluff.

Differences in the thickness of the loess were likewise found to be a linear function of the logarithm of the distance from the bluff. Between distances of 4 and 100 miles from the bluffs along the Cass-Mason county alluvial plain, the thickness of the loess is expressed by the equation $Y = 434 - 200 \log X$, when $Y =$ depth of loess in inches, and $X =$ distance from the bluffs in miles. At distances of less than three miles from the bluffs, the constants of the equation seemed to change abruptly.

The thickness of the loess originating in the American Bottoms, near St. Louis is expressed, for distances of less than twenty miles from the bluffs, by the equation $Y = 523 - 352 \log X$. At distances greater than twenty miles, the equation expressing the loess depths is $Y = 153 - 62 \log X$.

It is suggested that discontinuity in the rate of thinning of the loess may have been produced by seasonal or other variations in mean wind velocities during the period of loess deposition.

The calcium carbonate equivalent of the Peorian loess was found to decrease as the loess became thinner. This decrease was found to take place in all size fractions of the loess. The relationship between calcium carbonate equivalent and thickness of the loess is expressed in the equation, $Y = 41.6 - \frac{3224}{X}$, where Y = the calcium carbonate equivalent in percent, and X = the thickness of the Peorian loess in inches. The Standard Error of Estimate, S_{yx}, was 2.8%, and the carbonate content of the samples ranged from 39.2% to 7.0%.

The differences in carbonates are attributed to leaching during the period of loess deposition. The removal of a constant quantity of carbonates from loess deposits of varying thicknesses would result in reductions in the percentages of carbonates proportional to the reciprocal of the loess thickness. This is the observed relationship.

The loss of carbonates by leaching subsequent to the close of the period of loess deposition was found to be slightly more than half of the indicated loss during the period of deposition. Since the loess fossils indicate that the climate during the period of loess deposition was essentially the same as that of today, the annual leaching losses during the two periods should have been of the same order of magnitude. It is therefore concluded that the Peorian loess deposition was very slow.

If loess deposition occupied a long period, it is reasoned that there will be significant differences in the age of soils developed in loess deposits of varying thicknesses. Where the loess is thick, the portion of the loess deposit occupied by the solum has been subject to weathering during the period which has lapsed since loess deposition closed. Where the loess is thin, that portion of the deposit occupied by the solum has been subjected to an additional period of weathering, namely, the period during which the loess was being deposited. Using the loss of carbonates as a measure of the exposure to weathering, it is concluded that the Peorian loess in which the Cisne Series has developed has been exposed to much more weathering than has the parent loess of the Muscatine series.

Differences in character of the soil profiles developed in loess deposits of varying thicknesses are not closely associated with differences in the texture of the loess. Rather, the differences in soil character are associated with differences in the carbonate content of the loess, and the relative age, or exposure of the loess to weathering. Since the differences in soil character are those which might be expected to develop with differences in age, it is concluded that the greatest weight must be attached to the differences in the age of the loess in attempting to explain the differences in soil character. Other factors which may have influenced the development of the soils are the carbonate content of the loess, and the differences in the degree of weathering of the substratum immediately underlying the solum.

VITA

The author was born June 20, 1907, at Atlantic, Iowa. He attended grade schools in Des Moines, Iowa, Chicago and Kankakee, Illinois, graduating at Kankakee in the spring of 1924.

After working for a year, the author enrolled in the University of Illinois, and spent the next two years as a student. He then spent a year working in a Missouri mill, and following that he returned to the University of Illinois where he received his degree of Bachelor of Science, with Honors, in February, 1930. He was employed from that time to September 1933 as Assistant in Soil Physics and Soil Survey.

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The author is a member of Farm House, Phi Eta Sigma, Pi Delta Epsilon, Gamma Sigma Delta, Alpha Zeta, Sigma Xi, and Phi Kappa Phi.

The following are his more important publications:

Guy D. Smith, Experimental Studies on the Development of Heavy Claypans in Soils. Univ. of Mo. Res. Bul. 210, 1934.

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